

KHUTZEYMATEEN VALLEY GRIZZLY BEAR STUDY

Annual Progress Report - Year 1 (1989/90)

Annual Working Plan - Year 2 (1990/91)



**Ministry of
Environment
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**Wildlife Working Report No. WR-48
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Annual Working Plan - Year 2 (1990/91)

J.A. Nagy
A.G. MacHutchon

*A Cooperative Project Between the
Ministries of Environment and Forests*

Wildlife Branch
Ministry of Environment
Victoria, B.C.

Fish and Wildlife
Ministry of Environment
Smithers, B.C.

Integrated Resources Branch
Ministry of Forests
Victoria, B.C.

Research Branch
Ministry of Forests
Victoria, B.C.

Prince Rupert Forest Region
Ministry of Forests
Smithers, B.C.

North Coast Forest District
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1.0 BACKGROUND

The Khutzeymateen Valley Grizzly Bear Study is a component of the Khutzeymateen Project, a 3-year cooperative study designed to provide information necessary to develop a plan for future use of the Khutzeymateen watershed in north coastal British Columbia. A Project working plan was developed (Hamilton and Nagy 1990) and the first season of field study completed in 1989. This report summarizes progress in the first year and presents a working plan for year 2 - 1990/91.

2.0 OBJECTIVES

The objectives of the Khutzeymateen Valley Grizzly Bear Study are:

1. to test current concepts of seasonal habitat use and selection by coastal grizzly bears and, if necessary, to develop a revised conceptual model applicable to the Khutzeymateen ecosystem;
2. to identify, map, and determine the availability of habitat units and assess their relative importance to grizzly bears using the Khutzeymateen;
3. to identify and quantify the available resources (e.g., food, cover) within these habitat units and assess their relative importance to grizzly bears using the Khutzeymateen;
4. to estimate the population density of grizzly bears resident in the Khutzeymateen, and estimate the total number of bears using the watershed; and
5. to predict and assess the impacts of proposed land-use scenarios for the Khutzeymateen on grizzly bears and their habitats.

Data collection during the 1989 field season focused primarily on objectives 2, 3, and 4.

3.0 STUDY AREA

The study area includes the drainages of the Khutzeymateen River and Larch and Cedar creeks. The Khutzeymateen, Larch and Cedar drainages are located 45 km northeast of Prince Rupert at the head of Khutzeymateen Inlet. The study area is approximately 390 km² in area (Fig. 1).

The climate is wet, humid, mild, and oceanic (Banner and Yole 1986). As elevations increase, temperatures decrease and total precipitation and snowfall increase. Information summarized for five weather stations indicates that temperatures vary little throughout the year; the mean annual temperature is 7°C, the mean temperature of the warmest month is 16.1°C, while the mean of the coldest month is -3.1°C (Banner and Yole 1986). Precipitation is heavy; mean annual precipitation is 304 cm and mean annual snowfall is 356 cm (approximately 12% of the annual precipitation). Although winter conditions are not usually extreme, outflow winds can lead to freezing of Khutzeymateen Inlet. There was at least 30 cm of ice over 20 km² of the inlet on 9 March 1989.

Located in the Western Kitimat Ranges of the Coast Mountains, the topography of the Khutzeymateen is rugged. Elevations range from sea level to over 2100 m. Several active glaciers occur in the drainage. The terrain in the watershed has been mapped at 1:50 000 (Baender 1976). Major terrain units include: a large, active estuary, level fluvial areas (floodplain), some upslope units that are extremely shallow to bedrock, numerous avalanche chutes, organic bogs, and several fans. Soils are typically Humo-Ferric Podzols and Ferro-Humic Podzols in mid-slope positions, however Typic Folisols are common on shallow-to-bedrock sites.

Three biogeoclimatic zones are represented in the watershed: the Coastal Western Hemlock Zone (CWHvm and CWHwm Subzones), the Mountain Hemlock Zone (MHa Subzone), and

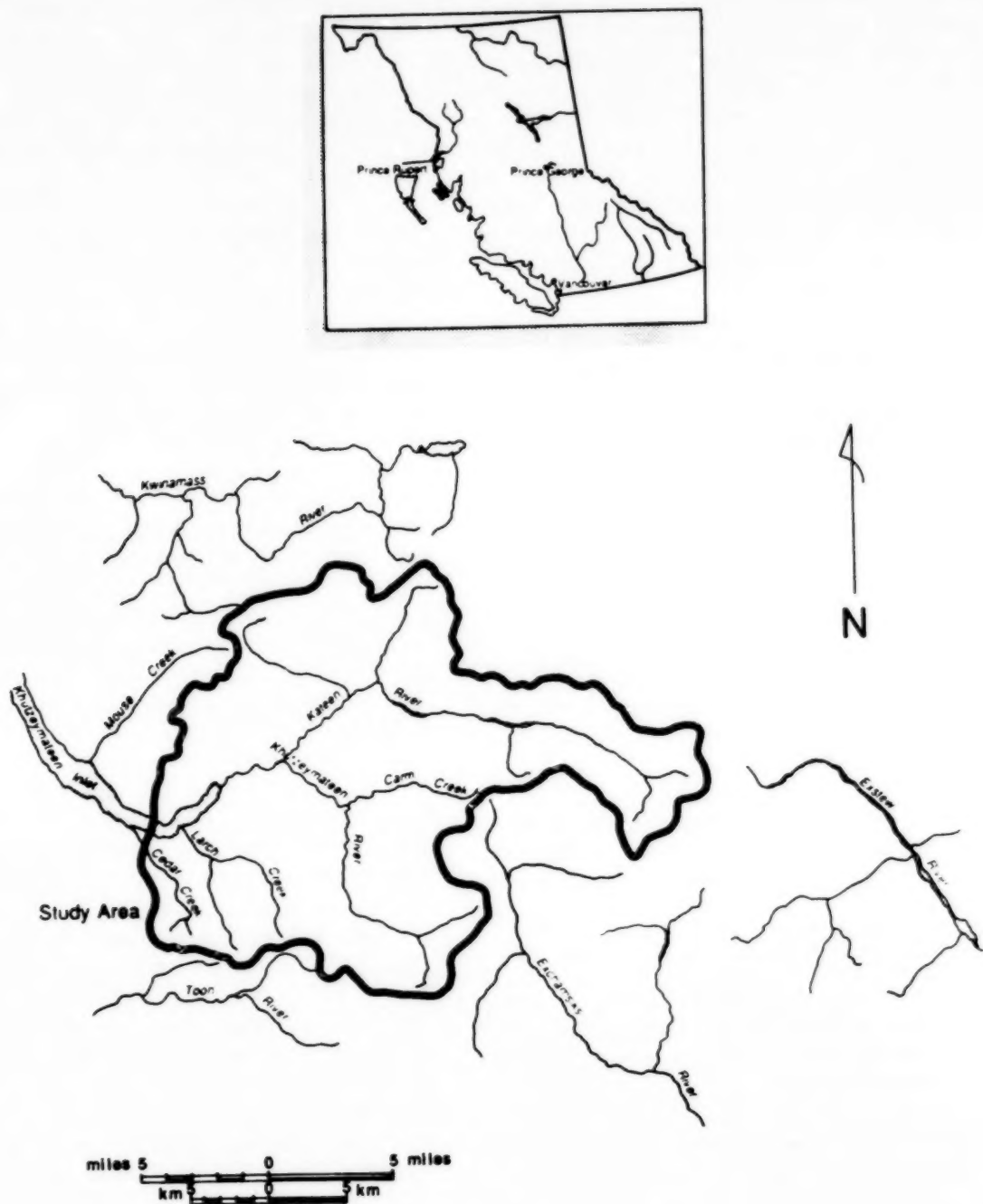


Figure 1. Boundaries of the Khutzeymateen Valley grizzly bear study area.

the Alpine Tundra Zone. The Very Wet Maritime (CWHvm) Subzone was formerly called the CWHi Subzone. Draft ecosystem classifications for the CWHi are available (e.g., Yole et al. 1982, Banner and Yole 1986). The zonal plant association (Pojar et al. 1987) is *Tsuga heterophylla* (western hemlock) - *Abies amabilis* (amabilis fir) - *Thuja plicata* (western redcedar) - *Vaccinium* spp. (blueberry, huckleberry species) - *Blechnum spicant* (deer fern) - *Rhytidiadelphus loreus* (lanky moss) - *Hylocomium splendens* (step moss). Seral associations on the Khutzeymateen floodplain appear typical of those further south with *Alnus rubra* (red alder) and *Populus balsamifera* ssp. *trichocarpa* (black cottonwood) dominating (Banner 1985). Some field sampling on logged sites has been completed in the Khutzeymateen Inlet as part of an investigation of the effects of porcupines (*Erethizon dorsatum*) on forest re-growth (Sullivan et al. 1986).

The fisheries resource of the Khutzeymateen has been estimated to have a commercial value as high as \$5 million annually (Jantz 1984). Net wholesale contribution to the economy is \$1.58 million per annum (Kremer 1985). For the years 1980-88, Khutzeymateen River escapements averaged 385 chinook, 4080 coho, 7610 chum, and 46 400 pink (Jantz et al. 1988). A few steelhead also spawn in the Khutzeymateen River. Chinook generally arrive in late July, start spawning in mid-August, and end by mid-September. Coho arrive in late August, begin spawning in late October, and end by early December. There are generally two runs of chum salmon. The first run arrives in mid-July, starts spawning in late July, and ends by mid-August. The second run of chum arrives in mid-August, starts spawning in late August, and ends in late September. Pink salmon arrive in mid-July, start spawning in early August, and end by mid-September (Jantz et al. 1988). In 1986, a salmon habitat inventory project was undertaken by the Department of Fisheries and Oceans (Karanka 1986).

In addition to grizzly bears, many other wildlife species occur in the Khutzeymateen watershed, including Bald Eagles (*Haliaeetus leucocephalus*), black bears (*Ursus americanus*), wolves (*Canis lupus*), mountain goats (*Oreamnos americanus*), and harbor seals (*Phoca vitulina*). The large estuary is an important staging area for migratory waterfowl.

There are three small Indian reserves (IR 38, 39, and 49) in the Khutzeymateen. Heritage resources of the watershed were examined during 1989 by the Archaeology and Outdoor Recreation Branch, Ministry of Municipal Affairs, Recreation, and Culture, in cooperation with the Port Simpson Indian Band (Eldridge 1989, Eldridge et al. 1990). Historic structures were located on the north shore of Khutzeymateen Inlet near the estuary and IR 49 along the lower Khutzeymateen River. Both sites were thought to be fishing camps (Eldridge et al. 1990).

The only significant logging to date in the Khutzeymateen watershed occurred in 1950, when a small stand of timber adjacent to the estuary was removed by Columbia Cellulose Ltd. (Karanka 1986), and 1956 when IR 49 was logged (Eldridge et al. 1990). Eldridge et al. (1990) found evidence that a logging road was built on the north side of Khutzeymateen Inlet and extended up the Khutzeymateen River, through IR 49, as far as 0.5 - 1 km west of the confluence of the Kateen River with the Khutzeymateen. Considerable volumes have been removed from Khutzeymateen Inlet by "A-frame" operators in the 1950's and 1960's (Sullivan et al. 1986) and by helicopter in the early 1980's, under a major Timber Sale Licence to Silver Grizzly Ltd.

4.0 PROGRESS MADE DURING 1989-90

4.1 Field Activities

Field work in 1989 was conducted between April 12 and October 20. Activities between April 12 and 28 included organizing camp and field equipment, removing log jams on the Khutzeymateen River to increase river boat access, transporting equipment, fuel and bait from Prince Rupert to camp, and constructing trapsites near the estuary. Trapping was conducted between April 29 and May 29. Field activities between May 30 and October 20 included weekly aerial telemetry surveys of radio-collared bears, frequent ground telemetry locations of accessible radio-collared bears, investigations at telemetry locations, establishing fixed ground telemetry stations, cutting trail up Carm Creek, removing obstacles from the river, providing logistic support for groups working in the valley, and maintaining and repairing field equipment.

4.2 Population Characteristics

4.2.1 Methods.— Two methods were used to identify the number of bears using the Khutzeymateen Valley: trapping and visual identification of distinct individuals. Grizzly bears were captured, immobilized, and handled using procedures described by Hamilton and Nagy (1990). Also, five helicopter surveys were conducted during the trapping period to search for grizzly bears or their sign in all drainages of the watershed (Fig. 2).

Visual searches of the Khutzeymateen River and Larch Creek estuaries and surrounding shorelines were made daily. Visual searches were made from the field camp in the morning and evening and when crossing the Khutzeymateen estuary by jet boat, helicopter or fixed-wing aircraft. Sightings made by other researchers were also recorded. Locations were plotted on air photos and the date, time, elevation, number of bears, activity, and habitat type were recorded. Each bear was described using standardized colour phase/pattern codes and sex and age class was recorded when possible (Appendix A).

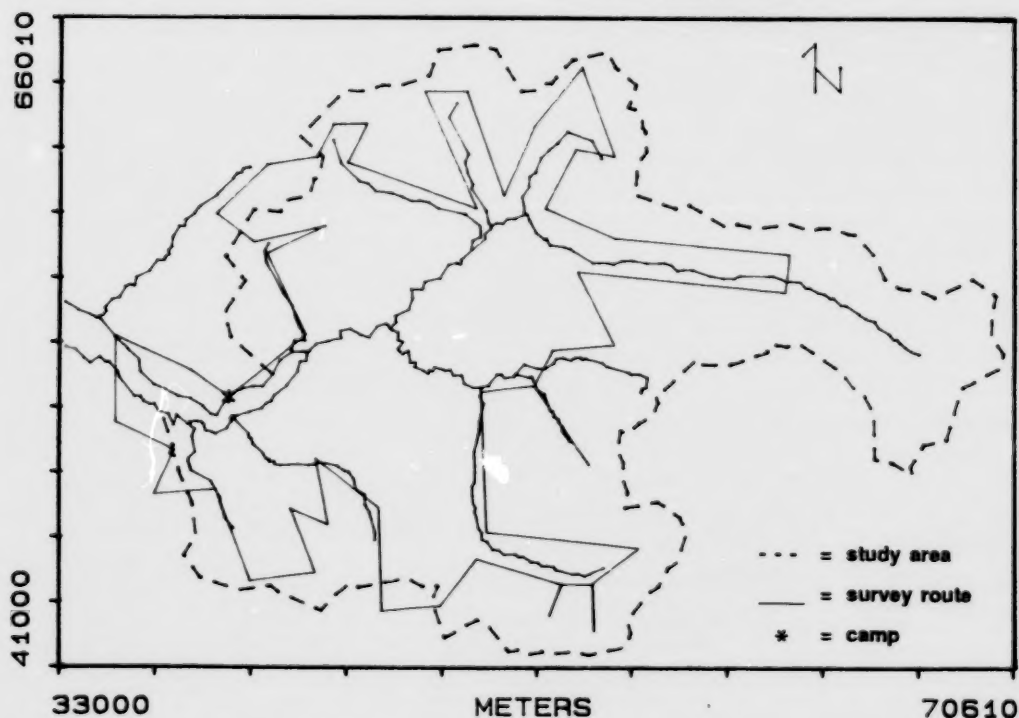


Figure 2. Route surveyed by helicopter for grizzly bears during the spring trapping period, 1989.

Data obtained during the capture program, intensive aerial surveys during the trapping period, and incidental sightings were used to derive estimates of the numbers of individual grizzly bears using the Khutzeymateen watershed on a seasonal or annual basis. In addition, incidental sighting and telemetry data were used to estimate the minimum number of potentially, likely, and positively different bears that used the Khutzeymateen estuary during days when observations were made. Potentially different bears included the number of bears observed in a day without any attempt made to account for multiple sightings of the same bears. The number of likely different bears was estimated by accounting for multiple sightings of the same bears. For example, when a light coloured bear was observed at different times during the day in the same general area we assumed that it was the same bear. Positively different bears included those bears that were distinctly different based on colour, known sex and age class (e.g., adult females with cubs), or radio-telemetry data, and bears observed during the same time frame (we often saw two or three bears feeding at separate locations or together at the same time). The estimates were

minimums, because the entire estuary was not visible from the field camp or river, observations were not systematically made every day due to commitments to other activities, and not all bears were expected to use the estuary during the periods of observation.

4.2.2 Results and Discussion.—

Trapping

Trapping commenced on April 29 at sites accessible by jet boat. Helicopter-monitored trapping activities were conducted from May 1 to 21. Trapping continued on the estuary at sites that could be reliably reached by jet boat until May 29 and opportunistically during late summer and fall. Traps were established at 35 sites located on the estuaries of the Khutzeymateen River and Cedar and Larch creeks, and along primary and secondary drainages of the Khutzeymateen and Kateen rivers, Carm, Coliseum, and Cedar creeks (Fig. 3) (Appendix B). A total of 495 trap-nights resulted in 33 captures (15 grizzly and 18 black bears) (Table 1). Capture rate was 1 bear per 15 trap-nights, 1 grizzly bear per 33 trap-nights, and 1 black bear per 28 trap-nights.

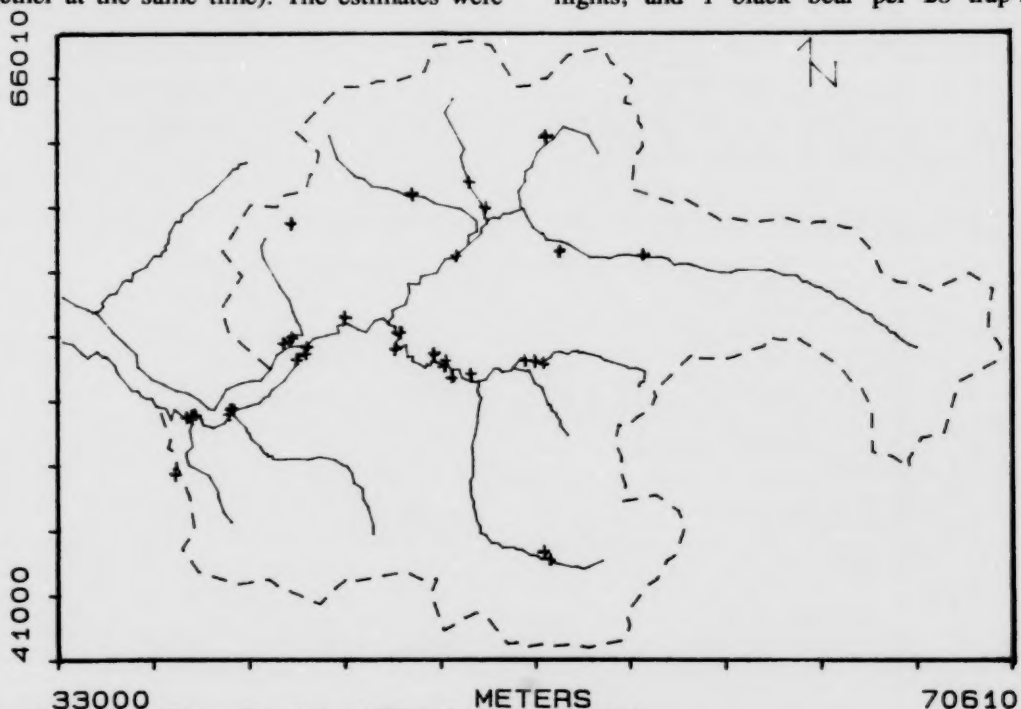


Figure 3. Location of trap sites during 1989 spring trapping period.

Table 1. Capture success in the Khutzeymateen watershed and Larch and Cedar drainages during the trapping period, 1989 April 29 to May 29.

Date	CAPTURES											
	Total			Grizzly			Black			Total		
	Trappnights	Trap Nights	Total	Day Total	Total	Day Total	Day Total	Total	Day Total	Total	Day Total	Total
29	0	0	0	0	0	0	0	0	0	0	0	0
30	6	6	0	0	0	0	0	0	0	0	0	0
1	9	15	0	0	0	0	0	0	0	0	0	0
2	12	27	0	0	0	0	0	0	0	0	0	0
3	14	41	0	0	0	0	0	0	0	0	0	0
4	14	55	1	1	1	1	1	1	2	2	2	2
5	15	70	1	1	2	1	1	2	2	2	2	4
6	16	86	0	0	2	1	1	3	1	5	1	5
7	19	105	1	3	2	1	4	7	2	7	7	7
8	19	124	0	0	4	0	4	8	0	8	0	8
9	19	143	1	4	4	0	4	9	1	9	1	9
10	22	165	1	5	4	0	4	9	1	9	1	9
11	26	191	0	0	4	0	4	11	0	11	0	11
12	26	217	1	6	5	1	5	13	2	13	2	13
13	24	241	1	7	6	1	6	15	2	15	2	15
14	27	268	0	7	8	2	8	17	2	17	2	17
15	24	292	1	8	9	1	9	19	2	19	2	19
16	28	320	1	9	11	2	11	21	3	21	3	21
17	23	343	1	10	12	1	12	23	2	23	2	23
18	28	371	1	11	13	1	13	25	2	25	2	25
19	29	400	3	14	14	1	14	28	2	28	2	28
20	25	425	0	14	15	1	15	30	1	30	1	30
21	31	456	0	14	17	2	17	32	2	32	2	32
22	7	463	0	14	17	0	17	33	0	33	0	33
23	6	469	0	14	17	0	17	34	0	34	0	34
24	6	475	0	14	17	0	17	34	0	34	0	34
25	6	481	0	14	17	0	17	34	0	34	0	34
26	5	486	1	15	17	0	17	35	1	35	1	35
27	3	489	0	15	17	0	17	35	0	35	0	35
28	4	493	0	15	18	1	18	36	1	36	1	36
29	2	495	0	15	18	0	18	36	0	36	0	36

Total of 15 individual grizzly and 17 individual black bears were captured.

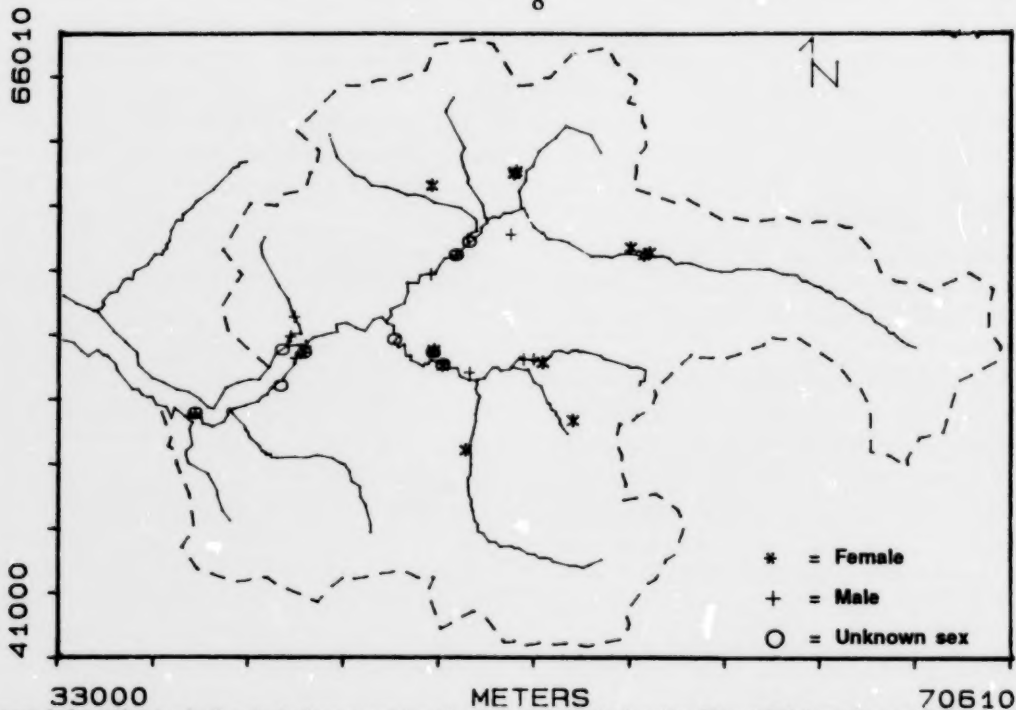


Figure 4. Locations of all grizzly bears captured or observed during the May 1989 trapping period.

was a lot of digging and scraping at the trap site and we found a small, (approx 75-100 kg) dead, partially consumed grizzly bear buried under moss and duff. The head and neck area were bloody, the body cavity had been split open, and the viscera partially consumed. The site and bear were photographed and some measurements were taken. We partially skinned the bear to determine the cause of death. There was extensive haemorrhaging in the neck area, the neck was broken, there were bite marks and puncture wounds on the skull, neck, and sides which indicated that GM17 was killed by another bear.

At the time of discovery, we thought that GM17 was a young of the female we had seen at TS-20 the previous day, however we observed the female with all three cubs on May 16. Because of the proximity of the female to the trap site where GM17 was killed, on the day that he was killed, we felt she may have killed GM17 while defending the bait at the site. GM17 had been captured at 2200 hours on May 14 (determined by back dating the time on transmitter clock) and was cold and stiff upon discovery which suggested the

bear was killed during the night. We reviewed our trapping procedures and concluded, with the exception of not trapping, there was no way that we could have prevented the mortality from occurring.

Incidental observations

During the field season, we made 276 incidental observations of grizzly bears (including multiple sightings of the same bears, females with cubs, yearlings, or subadults, mated pairs, and subadult groups). The distribution of those sightings is shown in Figure 5. Most bears were observed on the Khutzeymateen estuary or while we were travelling on the Khutzeymateen River.

We observed grizzly bears on the Khutzeymateen estuary and surrounding shoreline on 33 separate days between May 24 and July 15 (Table 3). An average of 3.4 potentially (range 1 to 10 bears), 2.9 likely (range 1 to 8 bears), and 2.6 positively (range 1 to 8 bears) different bears were observed per observation day. Most observations were made between 0700 and 1300 hours and 1600 to 2200 hours. These times reflect the periods

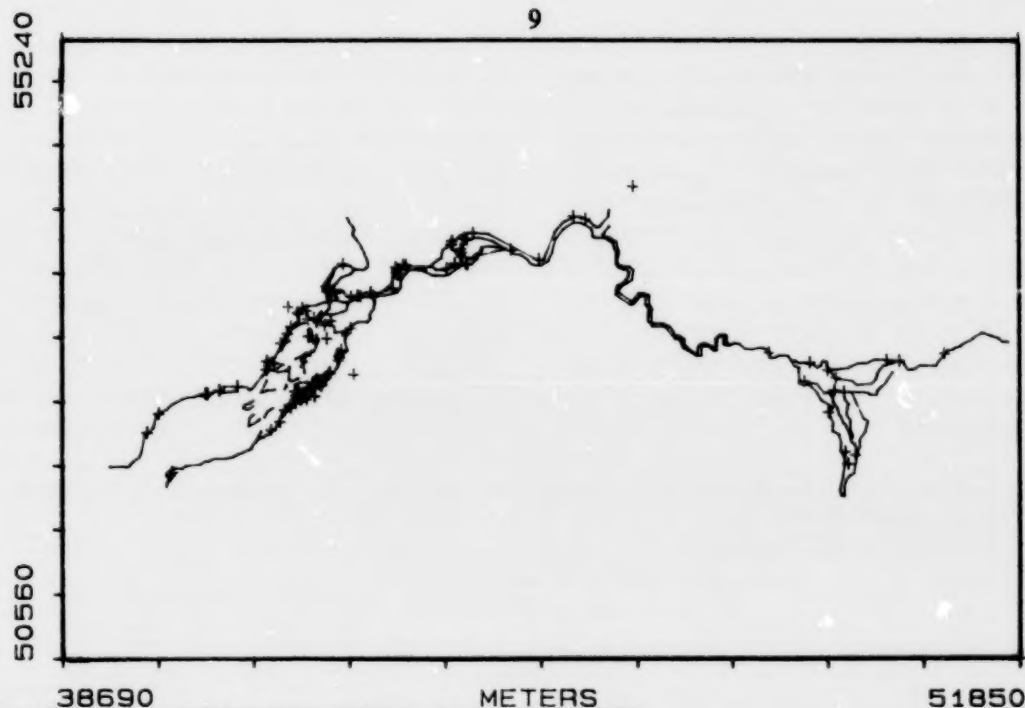


Figure 5. Location of all incidental sightings of grizzly bears, 1989.

when we travelled through the estuary or were at the field camp rather than the activity periods of bears. Our observations suggested that the Khutzeymateen estuary was an important spring-early summer foraging area for grizzly bears using the Khutzeymateen watershed.

Population estimate

At least 36 different grizzly bears used the Khutzeymateen valley on a seasonal or annual basis during 1989 (Table 4). We captured 17 different grizzly bears (11 males, 5 females, 1 unknown sex) and we observed 19 other identifiably different bears during aerial and ground surveys. We recognize that not all bears we identified were resident in the watershed throughout the year. For example, two of the males that were radio collared in spring 1989 used the Exchamsiks and Kwinamass watersheds and one female radio-collared in fall 1989 used Mouse Creek. These factors bias the estimate for the valley. On the other hand, we were conservative in identifying bears as different individuals or family groups. Some family groups we considered the same in our estimate were probably different. Similarly,

we chose not to guess whether a lone, uncollared bear was different from another lone, uncollared bear. Until more detailed information is available, we will not provide a population density estimate for the valley.

Physical characteristics

The physical measurements of all grizzly and black bears captured in 1989 are summarized in Appendices C and D, respectively. Kruskal-Wallis tests were used to compare the measured and estimated spring weights of mature males from Khutzeymateen watershed ($n = 5$) with those measured in the northern Yukon, where man-caused mortality has been light (Nagy et al. 1983a) ($n = 22$), and Tuktoyaktuk Peninsula, N.W.T. (Nagy et al. 1983b) ($n = 12$), west-central Alberta (Nagy et al. 1989) ($n = 9$), and Jasper National Park (Russell et al. 1979) ($n = 6$) where significant levels of man-caused mortality have occurred. The differences between spring weights of mature males in the Khutzeymateen (median weight 200 kg; range 170 to 290 kg) and northern Yukon (median weight 176 kg; range 105 to 227 kg) were marginally insignificant ($P = 0.053$). Spring weights of males in the

Khutzeymateen did not differ significantly from those in Tuktoyaktuk Peninsula, N.W.T. (median weight 191 kg; range 147 to 214 kg), west-central Alberta (median weight 257 kg; range 115 to 306 kg); or Jasper National Park (median weight 217 kg; range 170 to 290 kg).

The relative degree of fatness for male and female grizzly bears captured during May was estimated by a corpulence index (CI) (Kingsley et al. 1988). Corpulence indices were calculated as:

$$CI = WT/(LEN)^3$$

where WT = weight (kg) and LEN = straight line length (cm). The CI is a measure of relative fatness; higher CI indicates a higher proportion of adipose tissue.

Corpulence indices for males (ages 3 to 14 years) and females (ages 4 to 13 years) were 19 kg/m³ (range 15 to 24.1 kg/m³) and 20 kg/m³ (range 18.5 to 21.1 kg/m³), respectively. Corpulence index values for similar age classes

Table 3. Numbers of grizzly bears observed on and in areas surrounding the estuaries of the Khutzeymateen River and Larch and Cedar creeks between 1989 May 24 and July 14.

Date	Category of Different Bears			Number of Collared Bears Observed
	Potential ^a	Likely ^b	Positively different ^c	
May 24	2	2	2	-
May 25	2	2	2	1
May 26	1	1	1	-
May 28	1	1	1	-
June 5	9	8	7	2
June 6	5	5	3	-
June 7	8	6	4	1
June 8	10	6	5	-
June 9	4	4	4	-
June 10	5	4	3	-
June 11	2	2	2	-
June 16	3	3	3	-
June 17	1	1	1	-
June 18	2	2	2	-
June 19	2	2	2	-
June 21	3	3	3	-
June 22	5	5	4	1
June 23	6	6	6	-
June 24	9	8	8	-
June 25	3	2	1	-
June 26	3	2	2	1
June 27	3	2	2	-
June 28	2	2	2	-
July 1	5	3	3	-
July 3	2	1	1	-
July 5	1	1	1	-
July 6	2	2	2	-
July 7	2	2	2	-
July 8	2	1	1	-
July 9	3	2	2	-
July 11	1	1	1	-
July 12	3	2	2	-
July 13	1	1	1	-

^a Potentially different: total number of bears seen.

^b Likely different: excludes multiple sightings of the same bears.

^c Positively different: distinctly different bears based on colour, time of observation, known sex and age class, and telemetry data.

of males and females in northern Mackenzie, N.W.T., northern Yukon, and northern Alaska ranged from 14 to 28 kg/m³ and 18 to 22 kg/m³, respectively (Kingsley et al. 1988).

The CI values obtained for Khutzeymateen grizzly bears were not much different than those from more northern populations, which

suggests that their relative body condition following emergence does not differ from more northern populations. This is surprising considering the abundance of high quality late summer and fall foods (salmon) available to grizzly bears in the Khutzeymateen and the potential for fat deposition during the salmon spawning period. Possibly, bears in coastal

Table 4. Individual bears identified in the Khutzeymateen watershed during 1989.

Date Y • M • D	Bear I.D.	Sex	Age Class ^a	Location	Type of Observation
89.05.07	GFA1	F	Adult	Kateen River	Sighting
89.05.07	GUA2	U	Yearling	Kateen River	Sighting
89.05.07	GUA3	U	Yearling	Kateen River	Sighting
89.05.12	GFB1	F	Adult	Colleen Creek	Sighting
89.05.12	GUB2	U	Yearling	Colleen Creek	Sighting
89.05.12	GUB3	U	Yearling	Colleen Creek	Sighting
89.05.19	GF26	F	13	Trap Site 21A	Capture
89.05.19	GF27	F	4	Trap Site 21A	Capture
89.05.19	GUC3	U	4	Trap Site 21A	Sighting
89.05.13	GM13	M	4	Trap Site 21	Capture
89.05.20	GFD1	F	Adult	Tony Creek	Sighting
89.05.20	GUD2	F	Yearling	Tony Creek	Sighting
89.05.20	GUD3	F	Yearling	Tony Creek	Sighting
89.06.24	GF34	F	6	Khutz Inlet	Sighting
89.06.24	GUE2	U	Cub	Khutz Inlet	Sighting
89.06.24	GUE3	U	Cub	Khutz Inlet	Sighting
89.06.24	GUE4	U	Cub	Khutz Inlet	Sighting
89.05.16	GF18	F	13	Trap Site 16	Capture
89.05.18	GF24	F	4	Trap Site 24	Capture
89.05.12	GFH1	F	Adult	Grant Creek	Sighting
89.08.07	GF11	F	Adult	Khutz-Carm	Sighting
89.08.07	GUI2	U	Cub	Khutz-Carm	Sighting
89.08.07	GUI3	U	Cub	Khutz-Carm	Sighting
89.08.07	GUI4	U	Cub	Khutz-Carm	Sighting
89.08.07	GUJ1	F	Adult	Khutz-Carm	Sighting
89.08.07	GUJ2	U	Cub	Khutz-Carm	Sighting
89.05.04	GM02	M	3	Trap Site 17	Capture
89.05.05	GM04	M	14	Trap Site 12	Capture
89.05.07	GM06	M	6	Trap Site 11	Capture
89.05.09	GM08	M	9	Trap Site 10	Capture
89.05.10	GM09	M	14	Trap Site 13	Capture
89.05.12	GM11	M	10	Trap Site 22	Capture
89.05.15	GM17	M	3	Trap Site 20	Capture
89.05.17	GM22	M	3	Trap Site 19	Capture
89.05.19	GM25	M	3	Trap Site 9	Capture
89.05.26	GM32	M	14	Trap Site 3	Capture

^a Age Class: actual age determined from reading cemental annuli or estimated age based on reproductive status of females and size of young accompanying females.

systems cycle more weight on an annual basis than those in interior areas, or the energetic cost of winter denning and post-emergence survival is higher than that incurred in interior areas. If so, it emphasizes the importance of salmon for winter survival of bears in coastal systems.

Breeding age, litter size, age of weaning

Female GF18 (age 13 years) was in oestrous when captured on May 16. Female GF26 (age 13 years) was accompanied by three 4-year-old young when captured on May 19, but weaned them in early June; she would have bred at age 8.5 years. Female GF34 bred successfully at age 5.5 years and produced three cubs, in 1989, at age 6 years. The mean litter sizes for family groups identified in the Khutzeymateen watershed during 1989 were 2.3 cubs/litter ($n = 3$) and 2 yearlings/litter ($n = 3$).

4.3 Home Ranges and Movements

4.3.1 Methods.— Adult male and female grizzly bears were fitted with fixed-diameter radio collars (Telonics Ltd., Mesa, Arizona). A section of fire hose was inserted in each collar to ensure that it would drop off during or shortly after the study was completed. Radio collars were equipped with 5-second delay, pulse/reset devices so that general activity (moving, resting) could be inferred during aerial and ground monitoring. Battery life for the collars is estimated at 30 months. Radio collars were colour-coded to allow for visual identification of individuals.

Aerial tracking surveys began on May 29 and were conducted weekly until October 24. Bears were located using Cessna 180 or Beaver fixed-wing aircraft equipped with a directional H-antenna mounted on each wing at 30° to the horizon. Surveys were flown between 500- and 3000-m altitude until a signal was received. The location of each animal was established by maximum signal strength or visual sighting following low level searching. All locations and areas of associated uncertainty were

recorded on 1:50 000 NTS topographic maps and 1:15 000 colour air photos. Universal Transverse Mercator (UTM) coordinates (± 50 m) and elevations for all aerial locations were recorded. Ground telemetry locations of radio-collared bears began on June 8 and continued to October 16. Ground monitoring was conducted using a modification of a system described by Hamilton and Archibald (1986). Permanent radio-telemetry stations were established at intervals of 100 - 150 m along the Khutzeymateen River and Carm Creek. Approximately 45 ground telemetry stations were established and approximately 3 km of trail were cut to access Carm Creek. At each station, a 1.5-m length of 2.5-cm conduit pipe was driven vertically into the ground or log. A mobile telemetry pole, consisting of a 4-element antenna attached horizontally to the end of a second 1.5-m length of 2.5-cm conduit, could be rotated within the stationary pole. The antenna could be freely rotated 360° to obtain maximum signal strength. A compass was used to measure bearings, by sighting down the main axis of the antenna. Bearings were taken from at least 3 different telemetry stations to estimate a study animal's location. Often as many as 8 bearings were required before we were confident we were not tracking a signal bounce. Bearings were entered into a portable computer and the best estimate of the bear's location in UTM coordinates was determined using the program POLYGON (Page 1982). Aerial and verified ground telemetry location data and incidental sightings were used to determine home range size.

4.3.2 Results and Discussion.— Four adult male and four adult female grizzly bears were equipped with radio collars. Two males dropped their collars shortly after capture. All collared males were captured in the Khutzeymateen watershed or Larch and Cedar creek estuaries, and females were captured in the Kateen, Carm Creek, mid-Khutzeymateen River drainages, and upper Khutzeymateen Inlet. Estimates of 100% minimum convex polygon home range size are given in Table 5.

Grizzly bear female GF18

Female GF18 (13 years old in 1989) was captured near the junction of the Khutzeymateen and Kateen rivers on May 16. GF18 was lactating at the time of capture, but there was no evidence of young with her. She was in oestrous and was subsequently observed with a male, GM04, on May 20. GF18 primarily used sites in the lower portion of Carm Creek and the Khutzeymateen River below the Carm Creek junction. However, she made extended movements to the Khutzeymateen River and Larch Creek estuaries and to the upper Khutzeymateen River during the spring and early summer (Fig. 6). We obtained 31 locations for GF18 from May 16 to denning that resulted in a home range size estimate of 65 km² (Table 5).

Grizzly bear female GF24

GF24 (4 years old in 1989) was captured on the Kateen River on May 18. GF24 showed no evidence of previously having cubs; however, she appeared to be entering oestrous. GF24 was located entirely in the Kateen River drainage. Until July 20, her range was in the

headwaters of the Kateen River. After July 20, her activities were concentrated along the lower Kateen River (primarily a chum salmon spawning area; D. Wagner pers. comm.) (Fig. 7). We obtained 27 locations for GF24 from May 18 to denning that resulted in a home range size estimate of 39 km².

Grizzly bear female GF26

GF26 (13 years old in 1989), accompanied by three 4-year-old young, was captured near Carm Lake on May 19. One male and one female offspring were captured. GF26 was entering oestrous and lactating at the time of capture. We observed GF26 and her three subadult young three times before her capture. After her capture, she moved down river to the estuary (June 5) and remained in that general area until July 9 (Fig. 8). She weaned her young, at the estuary, sometime in early-June. After July 9, she began moving up river and arrived in the Carm Creek area around August 15. We could not always get good ground telemetry locations on GF26 after she entered Carm Creek because she occasionally moved to areas beyond ground telemetry range. GF26

Table 5. Estimates of 100% minimum convex polygon home range size for grizzly bears collared in the Khutzeymateen watershed or Larch and Cedar creeks, 1989.

Bear ID	Name	Sex	Age	Types of Locations Used to Estimate area of MCP ^a					100% MCP (km ²)
				CAP	IS	AT	SI	TOTAL	
GF18	Red	F	13	1	1	28	1	31	65.0
GF24	Yellow	F	4	1	0	26	0	27	39.0
GF26	Grey	F	13	1	4	16	24	45	22.0
GF34	White	F	6	1	21	6	18	46	22.0
GM04	B.J.	M	14	1	2	5	0	8	216.6
GM08	Tony	M	9	1	2	4	0	7	-
GM11	Bert	M	10	2	0	6	0	7	59.5

^a Types of Locations: CAP = capture site; IS = incidental sighting; AT = aerial telemetry location; and SI = site investigation.

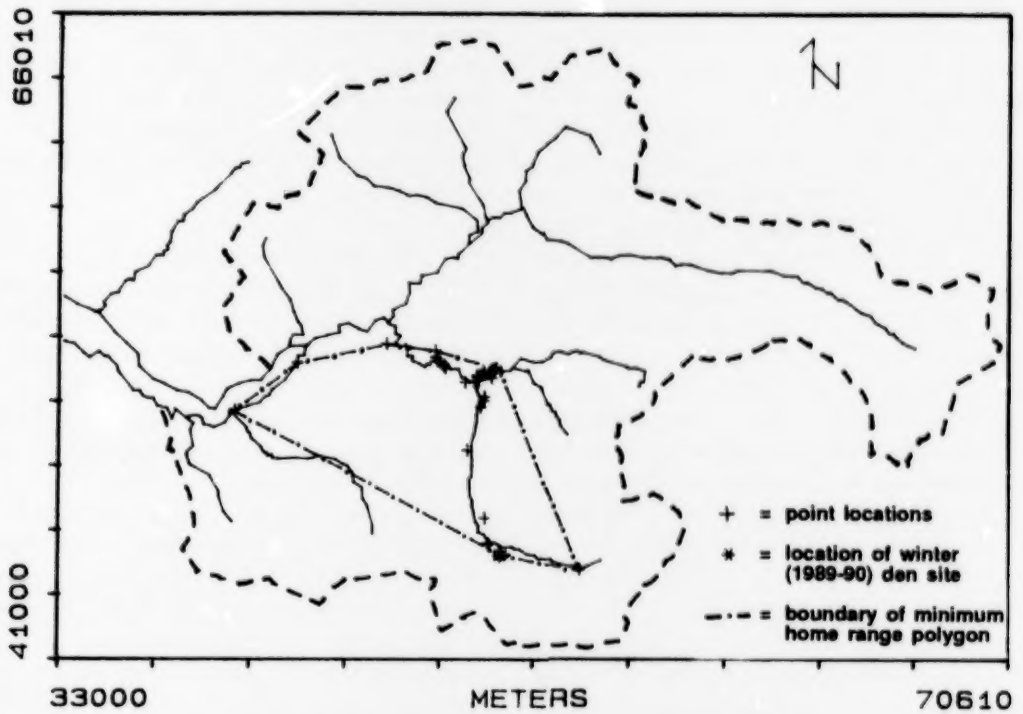


Figure 6. Minimum home range polygon for female grizzly bear GF18 (Red).

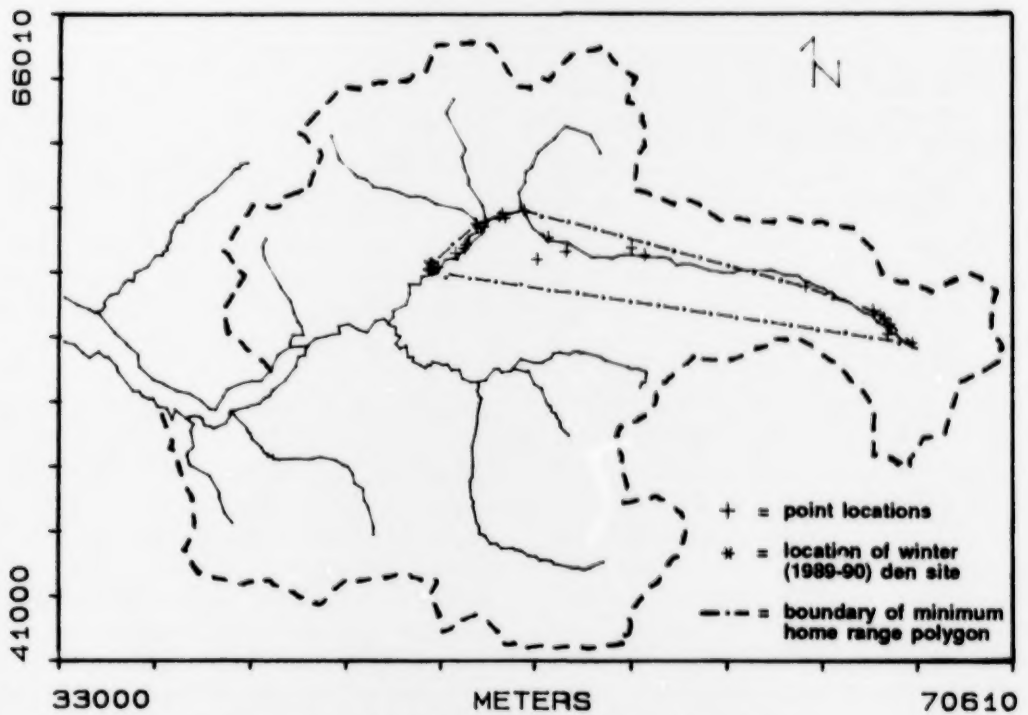


Figure 7. Minimum home range polygon for female grizzly bear GF24 (Yellow).

dropped her collar during early September along a salmon spawning channel of Carm Creek. We obtained 45 locations for GF26 from May 13 to early September that resulted in a home range size estimate of 22 km².

Grizzly bear female GF34

GF34 (6 years old in 1989), accompanied by three cubs, was captured on the north shore of the Khutzeymateen Inlet near the estuary on September 25. From September 9 to 21, before her capture, GF34 was observed on six separate days along the north shore of Khutzeymateen Inlet between Mouse Creek and Khutzeymateen River estuaries. After her capture, she remained in the area of the estuary and lower reaches of the Khutzeymateen River, before moving to Mouse Creek to den (Fig. 9). We obtained 46 locations for GF34 from September 9 to denning that resulted in a late summer and fall home range size estimate of 22 km².

Grizzly bear male GM04

GM04 (14 years old in 1989) was captured at a site adjacent to the Khutzeymateen River

estuary on May 5. We observed GM04 with two different females (unmarked and GF18) during the trapping period. After the trapping period, we were unable to relocate GM04 until September 5 when he was located along the Exchamsiks River approximately 40 km southeast of his capture site (Fig. 10). Long distance movements such as this are common among male grizzly bears. The eight locations obtained for GM04 resulted in a home range size estimate of 217 km². GM04's actual home range is probably much larger.

Grizzly bear male GM08

GM08 (9 years old in 1989) was captured at a site adjacent to the Khutzeymateen River estuary on May 9. He was observed over a period of 1 week with an unmarked female on Grant Creek (tributary NE of the Kateen River) (Fig. 10). GM08 dropped his collar in this area during the period May 29 to June 7. He was not monitored long enough to get a good measure of his home range size.

Grizzly bear male GM11

GM11 (10 years old in 1989) was first

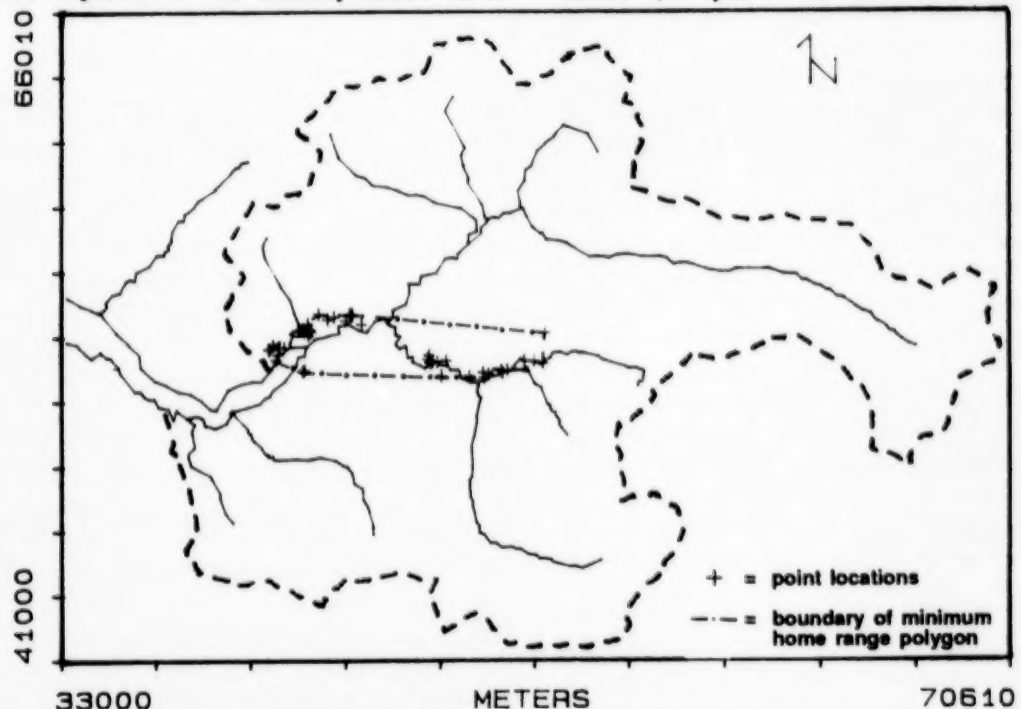


Figure 8. Minimum home range polygon for female grizzly bear GF26 (Grey).

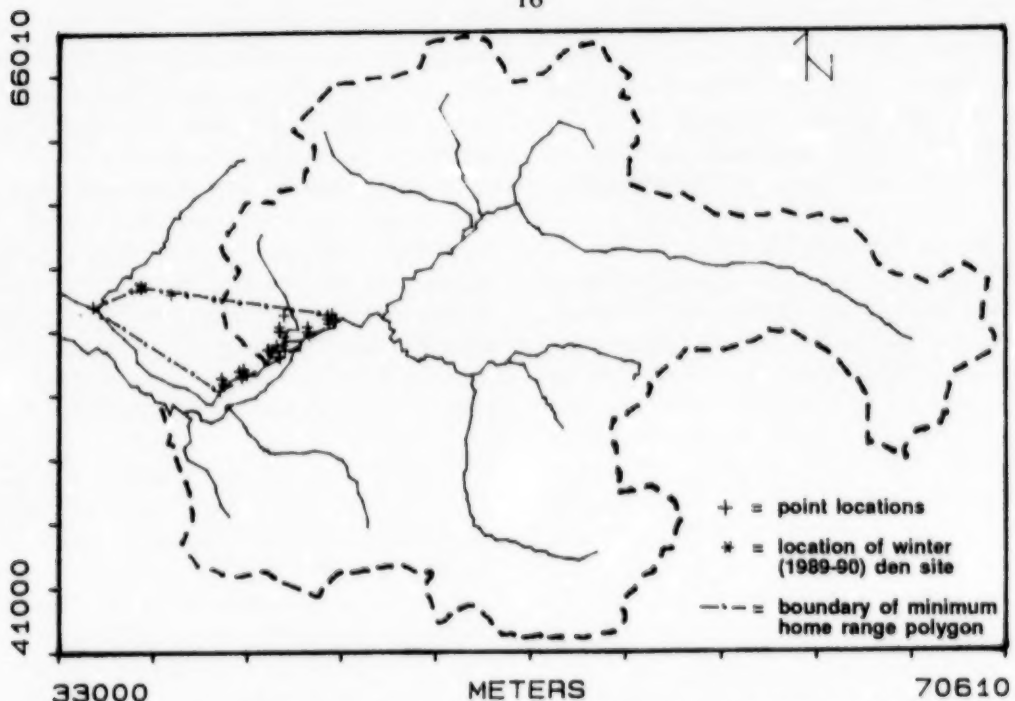


Figure 9. Late summer and fall minimum home range polygon for female grizzly bear GF34 (White).

captured on the Kateen River (May 12) and again on Larch Creek estuary (June 11). GM11 left the study area after the second capture. He reappeared in the watershed temporarily and was located once along the lower Khutzeymateen River (July 24). GM11 was not found again until September 5 when he was located near the headwaters of the Kwinamass River (Fig. 10). GM11 was located sporadically during 1989, but the 7 locations obtained resulted in a home range size estimate of 60 km². GM11's actual home range is undoubtedly much larger.

Grizzly bear male GM32

GM32 was captured on the Cedar Creek estuary on May 26. GM32 dropped his collar within 2 days of capture.

4.4 Habitat Use

4.4.1 Methods.— Aerial telemetry and ground telemetry location data were collected using the methods described in Section 4.3. When a bear moved away from the area where it was located, a ground investigation of the

location was conducted. Locations for subsequent ground visitation were selected using the following criteria:

1. error polygon <0.5 ha in area, and
2. location within 4 km hiking distance of the Khutzeymateen River corridor or the mouth of Larch or Cedar creeks.

Considerable effort was used to try and verify that sites of bear activity corresponded to the radio-collared bear being tracked. Verification criteria included: the presence of grizzly bear hair, the presence of appropriately sized grizzly bear tracks, proximity of the activity to the point of location, whether the bear was seen or not, the relative age of the sign, the presence of scat, and the nature of the disturbance. At each activity site where a site investigation was done, the following was recorded: activities of the bear, ecosystem unit, percentage of vegetation in different strata, percent cover of all vegetation species present, cover value of the site, location and description of beds, mark trees and mark trails, food species consumed,

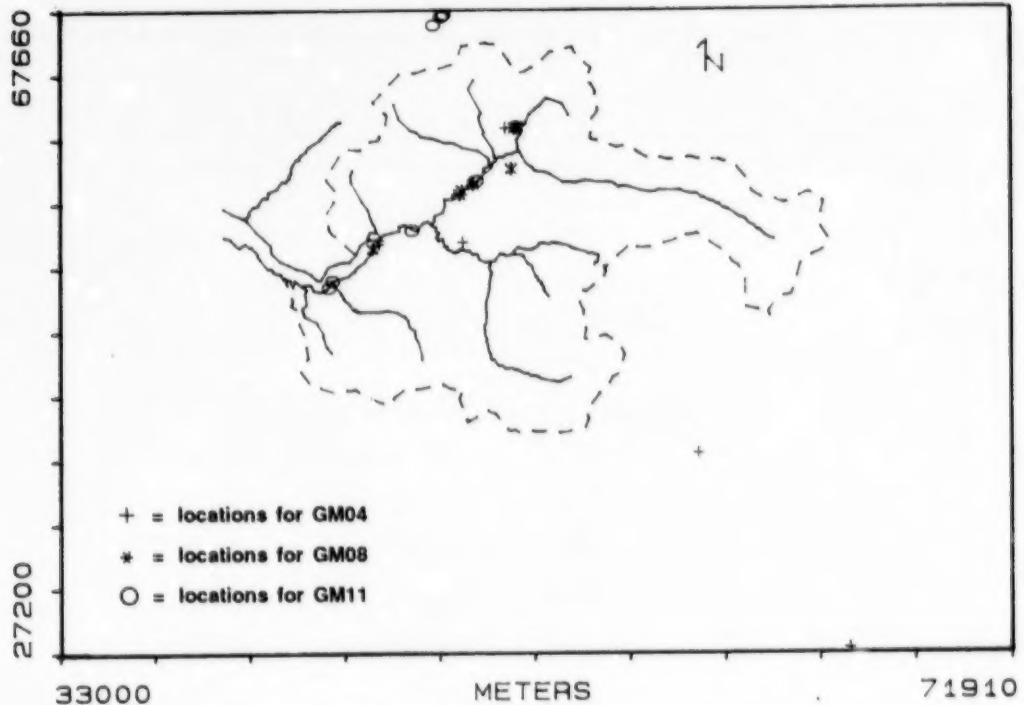


Figure 10. Aerial telemetry locations for male grizzly bears GM04, GM08, and GM11.

and distance to, availability and abundance of salmon. Cover value was measured by two researchers. One researcher would crouch at the centre of activity and the second researcher would walk in each of the four cardinal directions. For each direction, the first researcher would measure how far the second researcher walked before the lower half of his body disappeared from sight. Mean cover value was the mean of the four distances measured.

Aerial and ground telemetry locations were plotted on 1:15 000 colour aerial photos. The ecosystem unit for each aerial and ground telemetry location was first derived from maps prepared for the study area (Clement 1990), and then verified through photo interpretation by C. Clement, Shearwater Mapping Ltd., Victoria. The frequency of use of ecosystem units from aerial and verified ground telemetry locations was summarized by season. Seasons, defined by major shifts in food items consumed, were: season 1 - emergence to June 15; season 2 - June 16 to July 31; and season 3 - August 1 to October 20. Ecosystem units are described in Table 6.

Den sites were located using a Bell 206 helicopter. The location of each den site was plotted on 1:15 000 air photos. A 1-m diameter hoop, equipped with a transmitting device and wrapped with coloured flagging, was placed on top of a tree at or near the den site for subsequent location.

4.4.2 Results and Discussion.—

Patterns of habitat use for individual bears could not be accurately described after the 1989 field season because location and activity site investigation sample sizes were too small. In addition, the relative importance of sites used could not be determined because information on the availability of ecosystem units was not yet generated. Some general patterns of habitat use were evident from aerial, ground and incidental location data, however. Incidental locations of radio-collared bears were used in the habitat use analysis because they were definite locations where the bears were active. However, because bears were observed where they were most visible (rivers and estuaries primarily) and where the researchers travelled (rivers and trails), the

Table 6. Ecosystem units, seral associations where applicable, and successional stages of the Khutzeymateen watershed and Larch and Cedar drainages (Clement 1990).

Unit	Major vegetation association	Seral association	General vegetation of seral association	Successional stages ^a
CM	Cedar-moss	n/a	n/a	1-7
BM	Blueberry-moss	n/a	n/a	1-7
FF	Fern-foam flower	n/a	n/a	1-7
DC	Devil's club	n/a	n/a	1-7
FD	Floodplain devil's club	FD(1)	Alder-willow- <i>Rhacomitrium</i> -riverbar	1-7
		FD(2)	Alder-salmonberry	
		FD(3)	Alder-elderberry	
		FD(5)	Salmonberry-red-osier dogwood	
		FD(6)	Cottonwood-alder-salmonberry	
		FD(7)	Cottonwood-(alder)-devil's club	
		FD(8)	Cottonwood-spruce-salmonberry-devil's club	
		FD(9)	Cottonwood-alder-stink currant	
SC	Skunk cabbage	n/a	n/a	1-7
NW	Non-forested wetland	n/a	n/a	1-7
AV	Avalanche track	n/a	n/a	1-7
ES	Estuary	n/a	n/a	n/a
RO	Rock outcrop	n/a	n/a	n/a
RBAR	Gravel riverbar	n/a	n/a	n/a
BEACH	Sand riverbar	n/a	n/a	n/a

^a Successional stages: 1 = Non-vegetated; 2 = Herb; 3 = Shrub; 4 = Pole-sapling; 5 = Young forest; 6 = Mature forest; 7 = Old-growth.

magnitude of habitat use by ecosystem unit were biased. Therefore, caution is necessary when assigning meaning to the percentages given; although bears used all the habitats indicated, the proportion of use may not reflect true levels.

In 1989, we obtained 76 aerial telemetry locations for female ($n = 4$) and 14 for male ($n = 3$) grizzly bears, and 48 verified ground telemetry or incidental locations for radio-

collared females. Habitat use data were not summarized for males because location sample sizes were small and discontinuous. The frequencies, by season, that GF26 and GF18 and GF34 and GF24 were located in various ecosystem units are given in Table 7 and 8, respectively. Table 9 is a summary of all females combined.

We obtained habitat use data for three females (GF18, GF24, and GF26) from the end of May

Table 7. Ecosystem units used by radio-collared female grizzly bears GF26 and GF18 during 1989. Habitat use was based on aerial and ground telemetry locations and incidental sightings. All ecosystem units have been lumped by successional stage. The Blueberry-moss and Fern-foam flower ecosystem units were combined. No division was made between the seral associations of Floodplain devil's club ecosystem units.

Eco- units ^a	Successional stages ^b	GF26(Grey)				GF18(Red)			
		Season ^c		Total	% of total	Season ^c		Total	% of total
		1	2			1	2		
CM	1,2,3	0	0	0	0	0	0	0	0
CM	4,5,6	0	0	0	0	0	0	0	0
CM	7	0	0	0	0	0	0	0	0
BM-FF	1,2,3	0	0	0	0	0	0	0	0
BM-FF	4,5,6	0	0	0	0	0	0	0	0
BM-FF	7	2	0	2	5	1	0	3	13
DC	1,2,3	0	0	0	0	1	0	1	4
DC	4,5,6	0	2	2	5	0	0	0	0
DC	7	2	0	2	5	0	0	1	4
FD	1,2,3	0	7	8	21	0	2	3	21
FD	4,5,6	0	2	4	10	0	2	6	25
FD	7	0	1	3	10	0	0	3	13
SC	1,2,3	0	3	3	8	0	0	0	0
SC	4,5,6	0	0	1	3	1	1	3	13
SC	7	0	2	2	5	0	0	0	0
MHP	1-7	0	0	0	0	0	0	0	0
MM	1-7	1	0	1	3	0	0	0	0
ES		2	1	3	8	0	0	0	0
AV		0	0	0	0	0	2	2	8
NW		0	5	5	13	0	0	0	0
RBAR		0	0	2	5	0	0	0	0
BEACH		0	0	0	0	0	0	0	0
TOTAL		7	23	39		3	7	24	

^a Eco-units = Ecosystem units

^b Successional stages: 1 = Non-vegetated; 2 = Herb; 3 = Shrub; 4 = Pole-sapling; 5 = Young forest; 6 = Mature forest; 7 = Old-growth

^c Season 1 = emergence to June 15; Season 2 = June 16 to July 31; Season 3 = August 1 to October 20

Table 8. Ecosystem units used by radio-collared female grizzly bears GF34 and GF24 during 1989. Habitat use was based on aerial and ground telemetry locations and incidental sightings. All ecosystem units have been lumped by successional stage. The Blueberry-moss and Fern-foam flower ecosystem units were combined. No division was made between the seral associations of Floodplain devil's club ecosystem units.

GF34(White)					GF24(Yellow)				
Eco- units ^a	Successional stages ^b	Season ^c			% of total	Season ^c			% of total
		1	2	3		1	2	3	
CM	1,2,3		0	0	0	0	0	0	0
CM	4,5,6		0	0	0	0	0	0	0
CM	7		0	1	3	0	0	0	0
BM-FF	1,2,3		0	0	0	0	0	0	0
BM-FF	4,5,6		0	0	0	0	1	2	13
BM-FF	7		0	2	6	0	0	2	8
DC	1,2,3		0	0	0	0	0	0	0
DC	4,5,6		1	1	3	0	0	2	8
DC	7		0	4	13	0	0	0	0
FD	1,2,3		0	1	3	0	0	5	21
FD	4,5,6		0	2	6	0	0	2	8
FD	7		0	0	0	0	0	0	0
SC	1,2,3		0	0	0	0	0	0	0
SC	4,5,6		0	0	0	0	0	0	0
SC	7		0	0	0	0	0	0	0
MHP	1-7		0	0	0	0	0	1	4
MM	1-7		0	0	0	0	0	0	0
ES			1	10	35	0	0	0	0
AV	1,2,3		0	0	0	3	6	0	38
NW	1-7		0	0	0	0	0	0	0
RBAR			0	8	26	0	0	0	0
BEACH			0	1	3	0	0	0	0
TOTAL			2	29	31	3	7	14	24

^a Eco-units = Ecosystem units

^b Successional stages: 1 = Non-vegetated; 2 = Herb; 3 = Shrub; 4 = Pole-sapling; 5 = Young forest; 6 = Mature forest; 7 = Old-growth

^c Season 1 = emergence to June 15; Season 2 = June 16 to July 31; Season 3 = August 1 to October 20

Table 9. Ecosystem units used by radio-collared female grizzly bears during 1989. Habitat use was based on aerial and ground telemetry locations and incidental sightings. All ecosystem units have been lumped by successional stage. The Blueberry-moss and Fern-foam flower ecosystem units were combined. No division was made between the seral associations of Floodplain devil's club ecosystem units.

Eco-units ^a	Successional stages ^b	Season ^c				% of total
		1	2	3	Total	
CM	1,2,3	0	0	0	0	0
CM	4,5,6	0	0	0	0	0
CM	7	0	0	1	1	1
BM-FF	1,2,3	0	0	0	0	0
BM-FF	4,5,6	0	1	2	3	3
BM-FF	7	3	0	6	9	8
DC	1,2,3	1	0	0	1	1
DC	4,5,6	0	3	2	5	4
DC	7	2	0	5	7	6
FD	1,2,3	0	9	10	19	16
FD	4,5,6	0	4	10	14	12
FD	7	0	1	6	7	6
SC	1,2,3	0	3	0	3	3
SC	4,5,6	1	1	2	4	3
SC	7	0	2	0	2	2
MHP	1-7	0	0	1	1	1
MM	1-7	1	0	0	1	1
ES		2	2	10	14	12
AV	1,2,3	3	8	0	11	9
NW	1-7	0	5	0	5	4
RBAR		0	0	10	10	8
BEACH		0	0	1	1	1
TOTAL		13	39	66	118	

^a Eco-units = Ecosystem units

^b Successional stages: 1 = Non-vegetated; 2 = Herb; 3 = Shrub; 4 = Pole-sapling; 5 = Young forest; 6 = Mature forest; 7 = Old-growth

^c Season 1 = emergence to June 15; Season 2 = June 16 to July 31; Season 3 = August 1 to October 20

to September or October. GF18 was most often located in Floodplain devil's club (59%), Blueberry-moss/ Fern-foam flower (13%), and Skunk cabbage ecosystem units (13%). GF24 was most often located in Avalanche track (38%), Floodplain devil's club (29%), and Blueberry-moss/Fern-foam flower ecosystem units (21%). GF26 was most often located in Floodplain devil's club (41%), and Skunk cabbage ecosystem units (16%). Female GF34, captured in September, primarily used Estuary (35%), River bar/Beach (26%), Devil's club (16%), and Floodplain devil's club ecosystem units (9%).

The position of all aerial and verified ground telemetry locations and incidental sightings of radio-collared females in the Khutzeymateen watershed is shown in Figure 11. Overall, 74% of these locations occurred within the timber harvest operable zone. For individual females, 98% (GF26), 97% (GF18), 56% (GF24), and 46% (GF34) of their locations were within the timber harvest operable zone.

A total of 128 site investigations were done at 103 activity sites from June 8 to October 16. The spatial distribution of activity site investigations are shown in Figure 12.

Most site investigations were located in the Floodplain devil's club (32%), River bar/Beach (26%), Estuary (17%) and Devil's club (12%) ecosystem units (Table 10). Primary activities recorded during site investigations, included bedding ($n = 34$), feeding ($n = 80$), marking ($n = 8$), travel ($n = 5$), and other ($n = 1$). Many bedding and feeding sites were in Floodplain devil's club ecosystem units (42% and 34%, respectively) (Table 11). The mean cover value and the mean percent cover by vegetation strata at bedding, feeding, mark tree, and travel sites are given in Table 12. Grizzly bears tended to select more open vegetation for feeding and bedding during season 3 than during season 1 and 2.

The den sites of two adult females were located and marked from the air on 1990 February 7. Den sites will be visited on

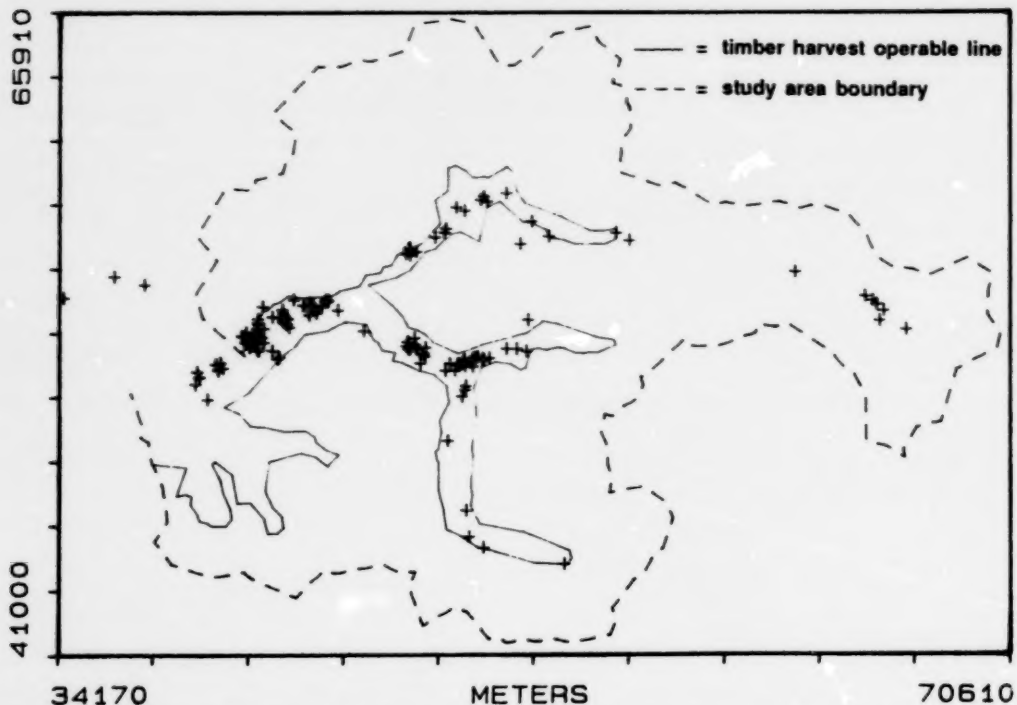


Figure 11. Distribution of all aerial and verified ground telemetry locations and incidental sightings of radio-collared female grizzly bears in relation to the timber harvest operable area.

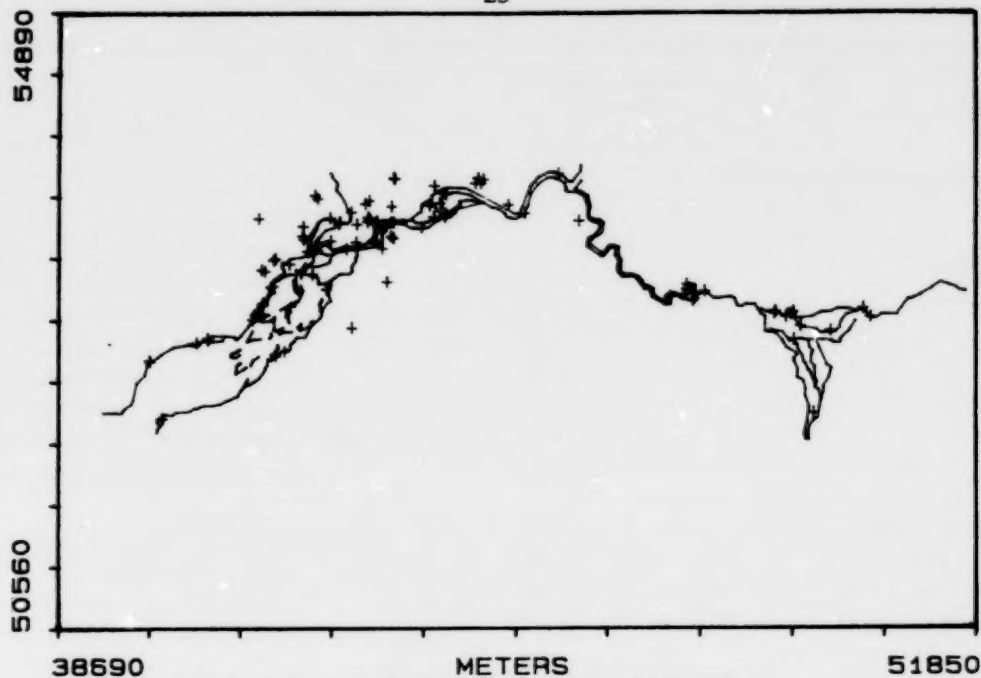


Figure 12. Locations of activity site investigations conducted in 1989

Table 10. Site investigation by ecosystem unit and habitat class.

Ecosystem Unit	Season*			% of seasonal sample			No. of sites by habitat class	% of sample
	1	2	3	1	2	3		
River bar/Beach	-	-	33	0	0	45	33	26
Estuary	3	9	10	33	20	14	22	17
BM7	2	1	2	22	2	3	5	4
Blueberry-moss	-	-	1	0	0	1	1	1
CM7	-	-	1	0	0	1	1	1
Cedar-moss	-	-	2	0	0	3		
DC3	-	4	-	0	9	0		
DC5	-	1	-	0	2	0		
DC6	2	2	4	22	4	5	15	12
DC7	-	-	3	0	0	4		
Devil's club	-	6	2	0	13	3		
FD4	-	1	0	0	0	1		
FD7	-	1	3	0	2	4		
FD(1)1	-	2	6	0	4	8		
FD(2)3	-	2	-	0	4	0		
FD(2)4	-	7	2	0	15	3		
FD(3)3	-	-	1	0	0	1		
FD(3)4	-	-	2	0	0	3		
FD(5)3	1	-	-	11	0	0		
FD(5)4	-	2	-	0	4	0		
FD(6)4	-	-	-	0	0	0		
FD(9)3	-	-	-	0	0	0		
Floodplain devil's club	-	5	-	0	11	0	41	32
NW2	-	-	-	0	0	0	5	4
Non-forested wetland	1	2	1	11	4	1		
SC2	-	1	-	0	2	0		
SC3	-	1	-	0	2	0		
SC7	-	-	-	0	0	0		
Skunk cabbage							6	5
TOTAL	9	46	73	100	100	100	128	100

* Season 1 = emergence to June 15; Season 2 = June 16 to July 31; Season 3 = August 1 to October 20.

Table 11. Bedding and feeding site investigations by ecosystem unit.

Ecosystem Unit	Bedding sites by season ^a			Feeding sites by season ^a			Total
	1	2	3	1	2	3	
River bar/Beach	-	-	5	-	-	26	31
Estuary	-	-	-	3	8	9	20
Blueberry-moss BM7	1	1	2	-	-	-	4
Cedar-moss CM7	-	-	-	-	-	-	0
Devil's club DC3	-	-	1	-	-	1	2
DC5	-	1	-	-	1	-	2
DC6	-	-	-	-	1	-	1
DC7	2	2	3	-	-	1	8
Floodplain devil's club FD4	-	-	2	-	-	1	3
FD7	-	1	1	-	-	-	2
FD(1)1	-	-	-	-	-	1	1
FD(2)3	-	-	1	-	1	2	4
FD(2)4	-	1	3	-	-	3	7
FD(3)3	-	1	-	-	1	-	2
FD(3)4	-	-	-	-	-	2	2
FD(5)3	-	2	1	-	5	-	8
FD(5)4	-	-	-	-	-	2	2
FD(6)4	-	-	-	1	-	-	1
FD(9)3	-	-	-	-	2	-	2
Non-forested wetland	-	-	-	-	5	-	5
Skunk cabbage SC2	-	1	-	1	1	1	4
SC3	-	-	-	-	-	-	0
SC7	-	1	-	-	1	-	2
TOTAL	3	11	19	5	26	49	113

^a Season 1 = emergence to June 15; Season 2 = June 16 to July 31; Season 3 = August 1 to October 20.

Table 12. Structural characteristics of vegetation at grizzly bear activity sites.

Activity by season ^a	N	Mean cover value ^b	Cover value range		% ground cover by vegetation strata ^c				
			Min.	Max.	Tree	B1	B2	C	D
Bedding Sites:									
1	3	39	23	52	70	10	15	27	28
2	11	26	14	47	1	4	5	84	5
3	19	74	8	216	50	1	10	5	80
Feeding Sites:									
1	5	77	63	130	1	4	5	84	5
2	26	76	18	327	5	20	23	62	2
3	47	147	20	328	8	5	9	29	3
Mark Tree:									
1	1	47	-	-	50	1	10	5	80
2	6	30	23	41	33	13	36	30	11
3	1	187	-	-	0	0	0	100	5
Travel:									
1	-	-	-	-	-	-	-	-	-
2	2	58	43	72	9	9	21	60	3
3	3	151	26	216	13	2	15	5	7

^a Season 1 = emergence to June 15; Season 2 = June 16 to July 31; Season 3 = August 1 to October 20.

^b Cover Value = A relative measurement of "bear sightability". See Section 4.4.

^c Tree = trees >10 m high; B1 = woody plants 2 - 10 m tall; B2 = woody plants <2 m high; C = herbaceous species; D = mosses, lichens, liverworts

the ground and described during the 1990-91 field season.

4.5 Diet

4.5.1 Methods.— Before the salmon spawning period, known-aged scats were collected opportunistically and frozen. During the salmon spawning period scat contents were noted *in situ*. Approximately 200 scats were collected and frozen for subsequent analyses. Only food habit data collected during field analyses of scats and from known feeding sites were summarized for this report.

4.5.2 Results and Discussion.— We recorded 227 separate instances of the use of food items, including 42 from scats examined in the field, 65 from incidental observations of feeding activity, and 120 from site investigations. Thirty-nine food items were recorded (Table 13). Major food items included:

1. sedges (primarily used May through early July);
2. skunk cabbage (primarily used May through July and September through October);
3. cow parsnip (primarily used late August through October);
4. elderberry (used in July);
5. highbush-cranberry, red-osier dogwood, and stink currant (primarily used August and September);
6. fresh and dead salmon (used August through October) (Table 14).

Grizzly bears were observed often during May, June, and early July on the estuaries of the Khutzeymateen River and Cedar and Larch creeks grazing on sedges (*Carex lyngbei*).

Three main salmon fishing and scavenging areas for grizzly bears were identified:

1. the lower Kateen River (chum and pink salmon spawning),

2. the Khutzeymateen River below the confluence of the Kateen and Khutzeymateen rivers (pink salmon spawning), and
3. the area around the confluence of Carm Creek and Khutzeymateen River (chum, pink, and coho salmon spawning).

Grizzly bears also fished and scavenged for dead salmon at the confluence of Coliseum Creek and the Khutzeymateen River and scavenged for dead salmon in tidal areas of the estuary. The area around the confluence of Carm Creek and the Khutzeymateen River was a major spawning area for pink and chum salmon in 1989. A minimum of 13 different grizzly bears used the area during August, September, and October. Both Carm Creek and the Khutzeymateen River are multi-channelled just upstream of the confluence, which provides numerous spawning beds for salmon and areas where salmon are readily available to fishing bears.

Some bears were observed digging for clams on mud flats at low tide and eating barnacles. A female and 3 cubs fed on barnacles along the shoreline of the inlet during June, and we collected several scats in which barnacle shells were present. A more detailed summary of food habits will be possible when scats, collected in 1989, are analyzed in 1990-91.

5.0 SUMMARY

1. Trapping activities were conducted from April 29 to May 29. A total of 495 trap-nights resulted in 33 captures (15 grizzly and 18 black bears). The capture rate was 1 grizzly per 33 trap-nights and 1 black bear per 28 trap-nights. Trapping activities were also conducted opportunistically during the summer and fall. Seventeen individual grizzly (11 males, 5 females, and 1 unknown sex) and 17 individual black bears (all males) were captured over the 1989 field season.

Table 13. Food items known to be consumed by grizzly bears in the Kutzeymateen watershed, 1989.

Food item	Portion consumed
<i>Angelica genueflexa</i>	roots, corms
<i>Athyrium filix-femina</i>	young fronds
Barnacles	entire
<i>Carex lyngbei</i>	leaves
<i>Carex suchensis</i>	tips of leaf blades
<i>Carex</i> spp.	tips of leaf blades
<i>Cicuta douglasii</i>	roots, flower heads
Clams	entire
<i>Conioselinum chinense</i>	flower heads
<i>Cornus sericea</i>	berries
<i>Deschampsia caespitosa</i>	tips of leaf blades
<i>Dryopteris assimilis</i>	young fronds
<i>Equisetum</i> spp.	leaves
Graminae spp.	tips of leaf blades
<i>Heracleum sphondylium</i>	roots, flower heads
Insects	entire
<i>Juncus</i> spp.	tips of leaf blades
<i>Ligusticum scoticum</i>	roots
<i>Lonicera involucrata</i>	berries
<i>Lupinus nootkatensis</i>	roots
<i>Lysichiton americanum</i>	underground portion of petioles
<i>Montia</i> spp.	roots, corms
<i>Oenanthe sarmentosa</i>	flower heads
<i>Oplopanax horridus</i>	buds, berries
<i>Osmorhiza chilensis</i>	roots, corms
<i>Osmorhiza</i> spp.	roots, corms
<i>Ribes bracteosum</i>	berries
<i>Rubus idaeus</i>	berries
<i>Rubus spectabilis</i>	berries
salmon-decomposed	not gill rakers and sperm sacks
salmon-fresh	not gill rakers and sperm sacks
<i>Sambucus racemosa</i>	berries
<i>Scirpus microcarpus</i>	tips of leaf blades
<i>Stachys mexicana</i>	leaves, stems
<i>Streptopus roseus</i>	berries
<i>Vaccinium alaskense</i>	berries
<i>Vaccinium</i> spp.	berries
<i>Veratrum viride</i>	berries
<i>Viburnum edule</i>	berries

Table 14. General chronology of use of major food items by grizzly bears in the Khutzeymateen Valley during 1989. Each month was divided into 4 periods.

[illegible]

2. One capture-related mortality occurred. A subadult male was killed by another bear while it was restrained in a snare.
3. During 1989, at least 36 different grizzly bears used the Khutzeymateen valley either seasonally or annually.
4. We made incidental observations of 276 bears (including multiple sightings of the same bears, females with cubs, yearlings, or subadults, mated pairs, and subadult groups). An analysis of incidental observations recorded in the estuary area indicated that a minimum of 8 different bears used the estuary during the spring-early summer.
5. Four adult male and four adult females were equipped with radio collars. We obtained movement data for four adult females. Home ranges for females ranged from 22 to 65 km² in size.
6. We obtained habitat use data for three females from May to October, and for one female during September and October. Overall, radio-collared bears were located in the Floodplain devil's club, Devil's club, and Estuary ecosystem units most often (57% of locations).
7. Seventy-four percent of aerial and verified ground telemetry locations and incidental sightings of radio-collared bears occurred within the timber harvest operable zone. These values ranged from 46 to 98% of locations for individual bears.
8. Aerial and ground telemetry surveys and incidental sightings provided locations for 128 site investigations at 103 grizzly bear activity sites. Most site investigations were in Floodplain devil's club (32%), Estuary (17%), and Devil's club (12%) ecosystem units. Many bedding and feeding sites were in Floodplain devil's club ecosystem units (42% and 34%, respectively).
9. Den sites of two adult females were located.
10. We identified 39 food items used by grizzly bears in the Khutzeymateen watershed. General seasonal feeding regimes were described.
11. Three primary grizzly bear salmon fishing and scavenging areas were identified, including the lower Kateen River, the Khutzeymateen River below the confluence of the Kateen and Khutzeymateen rivers, and the area around the confluence of Carm Creek and Khutzeymateen River.

6.0 1990-1991 WORKING PLAN

The purpose of this working plan is to outline the objectives of field and office activities for 1990-1991, and to describe the methods that will be employed to address each objective. For the overall project working plan, see Hamilton and Nagy (1990).

6.1 Objectives

Objectives for the field season and office sessions are:

1. to capture and radio collar 3-4 additional adult females and 2-3 adult males for a total sample of 5-6 females and 3-4 males.
2. to continue with weekly aerial telemetry and at least 3 ground locations/week of radio-collared grizzly bears to identify use areas.
3. to determine emergence times for 2 female grizzly bears radio collared during 1989 and to locate and describe the physiographic characteristics of their den sites.
4. to continue site investigations of known grizzly bears to evaluate the relative importance of habitats to grizzly bears.

5. to evaluate representative habitats in a portion of the Khutzeymateen watershed, including areas outside the operable line, to determine current levels of use and potential for use by grizzly bears.
6. to establish permanent plots in representative habitats to determine the vegetative and generative phenology of important grizzly bear plant foods.

6.2 Field Work

6.2.1 Capture and Handling.— Grizzly bears will be trapped, immobilized, handled, and fitted with radio collars using previously described procedures (Hamilton and Nagy 1990). Trapping activities will be conducted over 2 weeks during mid-May and mid-June. Grizzly bears will be immobilized with M99 (etorphine hydrochloride) or Ketamine-Rompun.

6.2.2 Aerial and Ground Monitoring.— Aerial and ground monitoring will be conducted using previously described procedures (Hamilton and Nagy 1990). Ground tracking will be conducted frequently along accessible portions of the Khutzeymateen and Kateen Rivers. In addition, grizzly bears that use areas beyond jet boat access will be monitored for several days during each bear season from fly-in camps.

6.2.3 Denning.— A reconnaissance aerial survey will be flown when the field crew returns to the watershed to check for activity at the den sites of the two female grizzly bears radio collared during 1989. If the bears are still in the dens, aerial surveys will be conducted periodically to establish general emergence times. The dens will be located after the bears leave and physiographic characteristics of each site will be recorded.

6.2.4 Habitat Use.— Monitoring of habitat use, activity site investigations, and scat collection will follow previously described

methods (Hamilton 1987, Hamilton and Nagy 1990).

Most of the grizzly bear site investigations done during 1989 were within the operable area. As a result, greater effort will be made during 1990 to obtain data on the levels of use and potential for use by grizzly bears of ecosystem units that occur outside the operable area. Representative ecosystem units (Clement 1990) will be evaluated within a test area in the lower portion of the Khutzeymateen watershed. The test area will be selected such that sample sites or areas are readily accessible by jet boat. Polygons of representative ecosystem units will be selected randomly for evaluation, with ecosystem units sampled in proportion to their occurrence within the test area. During each weekly or bi-weekly visit, the field crew will walk through the polygons to assess the type and intensity of grizzly bear activity, and describe the vegetative and generative phenological stage of grizzly bear plant foods (Walmsley et al. 1980). In addition, the proportion of stems with berries and the relative abundance of berries will be recorded for berry-producing species. The success of this procedure may be limited by available manpower and the difficulty of accessing sites outside the operable area.

6.2.5 Plant Phenology.— Phenology plots will be established along accessible portions of the lower, mid- and upper Khutzeymateen River to monitor grizzly bear food plants. Plots will be stratified by habitat type within each general area. The vegetative and generative stages (Walmsley et al. 1980) of plant food species will be monitored and recorded weekly or bi-weekly. The primary plant species monitored will be sedges (*Carex* spp.), small-flowered bulrush (*Scirpus microcarpus*), devil's club (*Oplopanax horridus*), red elderberry (*Sambucus racemosa*), blueberry (*Vaccinium* spp.), stink currant (*Ribes bracteosum*), red-osier dogwood (*Cornus sericea*), skunk cabbage (*Lysichiton americanum*), salmonberry (*Rubus spectabilis*), and Pacific crab apple (*Malus fusca*). In

addition, the proportion of stems with berries and the relative abundance of berries will be recorded for berry-producing species to determine seasonal patterns of berry availability.

6.3 Impact Assessment

The Ministry of Forests (MOF) and Ministry of Environment (MOE) formally agreed in June 1988 to undertake this cooperative study to assess the potential impacts of logging on grizzly bears and their habitats in the Khutzeymateen watershed. The Memorandum of Agreement (MOA) states that "if these assessments indicate that the impacts of logging on grizzly bears and grizzly bear habitats are unacceptable, then logging will be reconsidered". However, a working definition of "acceptable" levels of impact was not provided. As a result, a joint MOE and MOF committee was struck in December 1989 to provide that definition. The committee will develop a working model that will be used to assess the impacts of various timber management objectives on the ability of MOE to meet various grizzly bear management objectives in the Khutzeymateen watershed. The committee met on 24 January 1990 to identify some possible evaluation criteria.

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APPENDICES

Appendix A. Activity and age and sex class codes used to describe incidental sightings.

Activity		Age Class	
1	grazing	1	adult
2	running	2	subadult
3	at bait site	3	2 year old
4	resting/sitting	4	1 year old
5	bedded	5	cub
6	travelling	6	unknown
7	moving/feeding		
8	play/wrestling		
9	fishing/salmon		
10	feeding/unknown		
11	rubbing/mark tree		
12	swimming		
13	scavenging/salmon		
14	mark tree		
99	unknown		
		Sex	
		1	male
		2	female
		3	unknown

Appendix B. Location of trap sites in Khutzeymateen watershed, Larch and Cedar Creek drainages, spring 1989.

Trap Site	Location	UTM Coordinates	
		East	North
1	Cedar Estuary	437900	6050400
2	Cedar Estuary	438150	6050500
3	Cedar Estuary	438250	6050550
4	Larch Estuary	439600	6050550
5	Larch Estuary	439750	6050750
6	Larch Estuary	439750	605750
7	North Lagoon (lower Khutz River)	441750	6053450
8	North Lagoon (lower Khutz River)	442000	6053550
9	North Lagoon (lower Khutz River)	442100	6053700
10	Wolf Channel (lower Khutz River)	442300	6052800
11	Wolf Channel (lower Khutz River)	442650	6053050
12	Wolf Channel (lower Khutz River)	442700	6053300
13	Khutzeymateen River	444250	6054500
14	Khutzeymateen River	446400	6053900
15	Khutzeymateen River	446250	6053250
16	Khutzeymateen River	448200	6052525
17	Khutzeymateen River	447800	6053050
18	Khutzeymateen River	448275	6052775
19	Khutzeymateen-Carm Junction	449275	6052200
20	Lower Carm Lake	451450	6052750
21	Carm Lake	451850	6052750
21A	New Carm Lake	452225	6052650
22	Mid-Kateen	448700	6057050
23	Upper Kateen	449900	6059050
24	Upper Upper Kateen	456225	6057075
25	Grant Creek (Trib. N.E. of Kateen)	452325	6061900
26	Tracey Creek (Trib. N. of Kateen)	449200	6060075
27	Colleen Creek (Trib. N.W. of Kateen)	446900	6059600
28	Upper Mid-Upper Kateen	452925	6057200
29	Coliseum Creek (Trib. N. of estuary)	442075	6058375
30	Cedar Lake	437450	6048125
31	Upper Khutzeymateen River (slide)	452225	6044950
32	Upper Khutzeymateen River (floodplain)	452450	6044600
33	Khutzeymateen River (16A)	448475	6052075
34	Khutzeymateen estuary (slide)		

Appendix C. Grizzly bear capture data, Khutzeymateen watershed and Larch and Cedar drainages, spring 1989.

Bear	Day	Month	Year	UTM Coordinate		Sex ^a	Tattoo Number			Type of Capture ^b	Tooth Wear	Vulva Condition	Evidence of Nursing	Pelage Colour
				Easting	Northing		Groin	Lip	Ear					
GF18	16	5	89	448 200	6 052 525	F	18	18	18	CS	moderate	slightly swollen	lactate	brown
GF24	18	5	89	456 225	6 025 075	F	24	24	24	CS	moderate	swollen	normal	brown
GF26	19	5	89	452 225	6 052 650	F	26	26	26	TS	heavy	slightly swollen	lactate	brown
GF27	19	5	89	452 225	6 052 650	F	27	27	27	TS	minimal	normal	normal	brown
QM02	4	5	89	447 800	6 053 050	M	2	2	2	CS	minimal	N/A	N/A	brown
QM04	5	5	89	442 700	6 053 300	M	4	4	4	CS	heavy	N/A	N/A	brown
QM06	7	5	89	442 650	6 053 050	M	6	6	6	CS	minimal	N/A	N/A	brown
QM08	9	5	89	442 300	6 052 800	M	8	8	8	TS	mod-heavy	N/A	N/A	brown
QM09	10	5	89	442 250	6 054 500	M	9	9	9	CS	heavy	N/A	N/A	brown
QM11	12	5	89	448 700	6 057 050	M	11	11	11	CS	heavy	N/A	N/A	dk. brown
QM13	13	5	89	451 850	6 052 750	M	-	-	-	TS	minimal	N/A	N/A	lt. brown
QM17	15	5	89	451 450	6 052 750	M	-	-	-	TS	minimal	N/A	N/A	lt. brown
QM22	17	5	89	449 275	6 052 200	M	22	22	22	CS	minimal	N/A	N/A	lt. brown
QM25	19	5	89	442 100	6 053 700	M	25	25	25	TS	moderate	N/A	N/A	lt. brown
QM32	26	5	89	438 250	6 050 550	M	32	-	-	TS	heavy	N/A	N/A	dk. brown

^a Sex: M = Male; F = Female

^b Type of Capture: TS = Trail Set; CS = Cubby Set

AppendixC. Continued.

Bear	Hind Foot		Front Foot		Baculum Length (cm)	Testes Length (cm)
	Length (cm)	Width (cm)	Length (cm)	Width (cm)		
GF18	18.2	12.7	7.7	14.0	N/A	N/A
GF24	16.4	13.2	7.0	15.0	N/A	N/A
GF26	20.0	13.5	8.0	14.0	N/A	N/A
GF27	16.0	12.0	6.0	12.0	N/A	N/A
GM02	19.0	14.0			9.5	7.0
GM04	21.0	16.5	10.0	18.0	14.0	7.5
GM06	18.0	15.0	7.5	16.0	15.0	8.0
GM08	20.5	16.8	9.5	19.7	18.5	9.0
GM09	23.0	16.0	8.0	18.0	19.0	12.0
GM11	28.0	17.5	11.0	18.0	17.0	8.5
GM13	-	-	-	-	-	-
GM17	19.0	13.0	7.0	13.0	9.0	-
GM22	19.4	13.7	6.5	13.5	12.0	7.5
GM25	20.0	15.5	7.5	16.5	13.0	6.0
GM32	22.0	17.0	9.5	19.0	-	-

Appendix C. Continued.

Bear	Body Weight (kg)	Zygo Width (cm)	Skull Length (cm)	Total Length (cm)	Tail Length (cm)	Shoulder Height (cm)	Neck Girth (cm)	Heart Girth (cm)	Abdominal Girth (cm)	Canine Length (cm)	Canine Width (cm)	Canine Span (cm)
GF18	115	20.5	33.7	180.5	14.0	116.0	60.0	105.5	116.5	3.095	1.835	6.655
GF24	115	20.5	35.6	178.0	15.0	108.0	55.0	96.0	110.0	3.040	1.825	5.540
GF26	125-150	21.4	38.0	194.0	14.0	112.0	66.0	115.5	128.5	3.550	2.060	6.570
GF27	85	16.2	33.3	159.0	13.0	90.0	50.0	87.5	96.5	2.750	1.675	5.125
GM02	75	18.4	36.8	166.5	14.0	108.7	63.0	103.0	105.5	3.430	1.850	6.515
GM04	160-180	25.7	41.8	200.0	12.0	125.0	97.0	147.5	147.0	3.270	2.100	7.090
GM06	145	20.8	41.7	200.0	15.0	107.5	70.0	112.0	115.0	4.150	2.315	6.320
GM08	180-200	26.6	41.1	225.0	14.0	133.0	101.0	148.0	168.0	4.070	2.280	7.650
GM09	200	25.8	41.6	237.0	17.0	125.0	92.0	155.0	145.0	3.535	2.035	7.025
GM11	260	27.0	44.4	221.0	16.0	126.0	99.0	146.0	172.0	4.310	2.510	8.530
GM13	-	-	-	-	-	-	-	-	-	-	-	-
GM17	90-100	17.9	34.5	-	-	106.0	-	-	-	3.295	2.175	5.880
GM22	100	18.2	35.1	180.0	14.0	107.0	53.0	97.0	104.0	3.120	1.640	6.290
GM25	130	19.0	36.6	183.0	14.0	95.0	60.0	100.0	113.0	3.710	1.890	6.610
GM32	275-300	25.5	41.8	-	-	-	99.0	-	-	-	-	-

Appendix D. Black bear capture data, Khutzeymateen watershed and Larch and Cedar drainages, spring 1989.

Bear	Day	Month	Year	UTM Coordinate		Sex	Tattoo Number			Type of Capture	Tooth Wear	Vulva Condition	Evidence of Nursing	Pelage Colour
				Easting	Northing		Grain	Lip	Ear					
BM01	4	5	89	442 100	6 053 100	M	1	1	1	TS	moderate	N/A	N/A	black
BM03	5	5	89	442 000	6 053 550	M	3	3	3	CS	moderate	N/A	N/A	black
BM05	6	5	89	438 250	6 050 550	M	5	5	5	CS	minimal	N/A	N/A	black
BM07	7	5	89	449 900	6 059 050	M	7	7	7	TS	moderate	N/A	N/A	black
BM10	12	5	89	437 900	6 050 400	M	10	10	10	TS	minimal	N/A	N/A	black
BM12	13	5	89	449 275	6 052 200	M	12	12	12	CS	minimal	N/A	N/A	black
BM14	14	5	89	442 075	6 058 375	M	14	14	14	CS	moderate	N/A	N/A	black
BM15	14	5	89	449 900	6 059 050	M	15	15	15	CS	moderate	N/A	N/A	black
BM16	15	5	89	448 200	6 052 525	M	16	16	16	TS	minimal	N/A	N/A	black
BM19	16	5	89	448 200	6 052 525	M	19	19	19	TS	minimal	N/A	N/A	black
BM19	20	5	89	448 275	6 052 775	M	19	19	19	TS	-	-	-	black
BM20	16	5	89	456 225	6 057 075	M	20	20	20	CS	moderate	N/A	N/A	brown
BM21	17	5	89	437 450	6 048 125	M	21	21	21	CS	moderate	N/A	N/A	dk. brown
BM23	18	5	89	448 475	6 052 075	M	23	23	23	CS	minimal	N/A	N/A	brown
BM28	19	5	89	452 325	6 061 900	M	28	28	28	TS	moderate	N/A	N/A	black
BM30	21	5	89	442 075	6 058 375	M	30	30	30	TS	heavy	N/A	N/A	black
BM31	21	5	89	452 225	6 044 950	M	31	31	31	CS	moderate	N/A	N/A	black
BM33	27	5	89	442 700	6 053 300	M	33	-	-	TS	moderate	N/A	N/A	black

Sex: M = male; F = female

Type of Capture: TS = trail set; CS = cubby set

Appendix D. Continued.

Bear	Hind Foot		Front Foot		Baculum Length (cm)	Testes Length (cm)
	Length (cm)	Width (cm)	Length (cm)	Width (cm)		
BM01	15.5	11.5	6.3	12.8	18.0	10.0
BM03	16.5	12.0	6.4	13.0	17.8	7.0
BM05	16.3	9.7	6.2	12.2	14.0	8.0
BM07	16.5	12.0	6.3	12.5	18.8	8.2
BM10	15.0	11.0	6.5	12.5	17.0	7.5
BM12	14.5	11.0	6.0	11.5	15.0	4.0
BM14	17.0	11.0	6.5	11.5	20.0	8.0
BM15	15.0	12.0	6.5	13.0	19.0	8.0
BM16	14.0	10.8	6.0	11.0	14.5	8.0
BM19	15.0	11.5	7.0	12.0	19.0	6.0
BM19	-	-	-	-	-	-
BM20	17.0	13.0	8.0	14.0	16.0	7.0
BM21	14.8	11.5	6.4	12.3	18.0	7.0
BM23	12.0	9.0	6.0	9.0	11.0	6.0
BM28	15.8	10.5	6.5	12.0	18.0	8.0
BM30	14.0	10.0	5.3	11.4	17.0	6.5
BM31	15.0	12.0	7.0	12.5	17.0	8.0
BM33	15.0	10.0	6.0	12.0	15.0	7.5

Appendix D. Continued.

Bear	Body Weight (kg)	Zygo Width (cm)	Skull Length (cm)	Total Length (cm)	Tail Length (cm)	Shoulder Height (cm)	Neck Girth (cm)	Heart Girth (cm)	Abdominal Girth (cm)	Canine Length (cm)	Canine Width (cm)	Canine Span (cm)
BM01	125	19.3	33.0	166.0	12.0	94.0	64.0	120.0	123.0	2.890	1.760	5.420
BM03	62	18.5	28.5	160.0	7.0	89.0	61.0	87.0	96.5	2.915	1.675	5.285
BM05	65	16.6	31.5	158.0	6.5	91.5	20.0	85.0	89.0	2.320	1.400	5.240
BM07	70	18.6	31.5	172.0	6.0	106.0	60.0	97.0	106.0	3.630	1.795	5.755
BM10	95	18.5	22.6	162.0	10.0	89.0	56.0	92.0	96.0	2.805	1.715	5.375
BM12	90	18.1	31.4	160.0	9.0	86.0	61.0	97.0	99.0	3.200	1.760	5.520
BM14	135	18.6	31.5	174.0	8.5	107.5	63.5	108.0	113.0	3.460	1.650	5.320
BM15	90-100	19.1	29.0	166.0	11.0	93.0	61.0	95.0	105.0	2.590	1.660	5.930
BM16	90	18.5	32.5	168.5	11.5	102.0	54.5	93.0	102.5	2.680	1.445	5.015
BM19	85	18.0	30.1	160.5	8.0	85.0	60.0	86.5	97.0	2.855	1.595	5.360
BM20	n/a	19.5	32.8	179.0	9.0	95.0	69.0	108.0	118.0	3.17	1.920	5.660
BM21	100	19.0	30.3	166.0	10.0	94.0	62.0	98.0	104.0	3.015	1.760	5.800
BM23	35	13.3	25.9	123.0	9.0	73.0	38.0	65.0	72.5	2.615	1.360	4.535
BM28	85	17.2	32.2	164.0	12.0	91.0	58.0	89.0	93.0	3.050	1.630	5.280
BM30	95	18.8	27.9	163.0	11.0	84.0	61.0	98.0	103.0	2.850	1.590	5.222
BM31	100	19.6	31.2	169.0	10.0	94.0	65.0	112.0	120.0	2.745	1.975	5.505
BM33	75	17.4	31.4	160.0	13.0	91.0	54.0	82.0	97.0	3.215	1.825	5.420

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